PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : B32B 15/02, G08C 21/00

A1

(11) International Publication Number: WO 92/16368

(43) International Publication Date: 1 October 1992 (01.10.92)

(21) International Application Number: PCT/US92/01876

(22) International Filing Date: 10 March 1992 (10.03.92)

(30) Priority data:
673,768 20 March 1991 (20.03.91) US

(71) Applicant: CALCOMP INC. [US/US]; 2411 W. La Palma Avenue, Anaheim, CA 92803 (US).

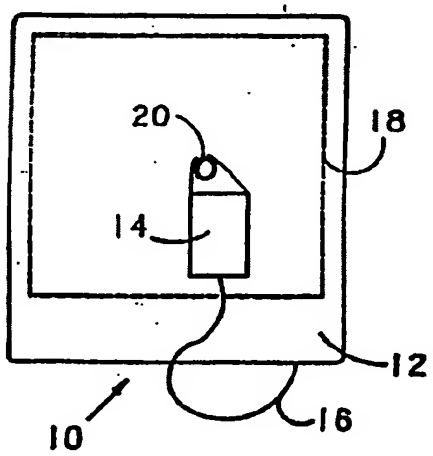
(72) Inventors: LONG, Gary, R. ; 6432 E. Bluebird Lane, Paradise Valley, AZ 85253 (US). DOUBRAVA, Dana ; 3649 W. Andora Drive, Phoenix, AZ 85029 (US).

(74) Agents: DAVIS, Anthony, G., M. et al.; Davis, Bujold & Streck, 175 Canal Street, Manchester, NH 03101 (US).

(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), MC (European patent), NL (European patent), SE (European patent).

Published
With international search report.
With amended claims.

(54) Title: FLEXIBLE DIGITIZER TABLET



(57) Abstract

This is a flexible digitizer tablet (12") for sensing the position of a cursor coil (20) radiating a magnetic field therefrom and thereby a cursor (14) carrying the cursor coil (20) without signal interference and distortion adjacent edges of an active area of the table (12"). There is a bottom layer (28') of a flexible insulating material, a grid of wires (30') on a flexible substrate comprising the active area of the tablet (12") and a shunt layer (34) of a flexible metal foil disposed between the substrate carrying the grid of wires and the bottom layer (28').

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MN	Mongolia
BE	Belgium	GA	Gabon	MR	Mauritania
BF	Burkina Faso	GB	United Kingdom	MW	Malawi
BG	Bulgaria	GN	Guinea	NL	Netherlands
BJ	Benin	GR	Greece	NO	Norway
BR	Brazil	HU	Hungary	PL	Poland
CA	Canada	IT	Italy	RO	Romania
CF	Central African Republic	JP	Japan	RU	Russian Federation
CG	Congo	KP	Democratic People's Republic of Korea	SD	Sudan
CH	Switzerland			SE	Sweden
CI	Côte d'Ivoire	KR	Republic of Korea	SN	Senegal
CM	Cameroon	LI	Liechtenstein	SU	Soviet Union
CS	Czechoslovakia	LK	Sri Lanka	TD	Chad
DE	Germany	LU	Luxembourg	TG	Togo
DK	Denmark	MC	Monaco	US	United States of America

FLEXIBLE DIGITIZER TABLET

Background of the Invention:

This invention relates to digitizer tablets and, more particularly, in a flexible digitizer tablet comprising a grid of wires on a flexible substrate, to the improvement to eliminate signal interference adjacent edges of a sensing area of the grid of wires comprising a shunt layer of a flexible metal foil disposed in close-spaced parallel relationship to the grid of wires.

Digitizer tablets for inputting positional information into computers for use by programs running therein are well known in the art. The majority of digitizer tablet systems are as shown in Figure 1. The system 10 comprises a tablet 12 and a cursor 14 which is moved over the tablet 12. The cursor 14 is connected to the tablet 12 by the connecting cable 16 and to a computer (not shown for simplicity) by another connecting cable (also not shown). The tablet 12 is rigid in structure and contains a grid of wires as indicated by the dashed box 18. The cursor 14 includes an electrical coil 20 through which a current is pulsed to generate a magnetic field surrounding the coil 20. As the cursor 12 is moved over the tablet 12, the magnetic field being produced by the coil 20 is sensed by the sensing wires of the grid and thereby the position of the cursor 12 on the surface of the tablet 12 is determined.

Some attempts have been made in the prior art to produce a flexible digitizer tablet as illustrated in Figure 2 where it is labeled as 12'. A flexible digitizer tablet has advantages in certain applications. For example, it can be rolled up for storage instead of taking up its full space. The flexible tablet 12' has a grid of wires 18 just as in the solid tablet 12 of Figure 1 except that the wires 18 are printed onto the substrate material forming the flexible tablet 12' instead of merely being supported by the tablet 12. While prior art flexible digitizer tablets work for their intended purpose in general, they have problems adjacent the edges which have made them

unacceptable for commercial purposes. The major problem of prior art flexible digitizer tablets is illustrated in Figure 5. The grid of wires 18 adjacent its edges includes repeat wires 22, interconnecting wires 24, and a return wire 26. The magnetic field 38 produced by the coil 20 extends outward surrounding the coil 20 in the manner illustrated in Figure 5. Thus, as the coil 20 is brought close to the edge of the working area of the tablet 12', the magnetic field 38 radiates into the repeat wires 22, interconnecting wires 24, and a return wire 26 causing significant interference with the data indicating the position of the coil 20 (and thereby the cursor 14) on the surface of the tablet 12'.

Wherefore, it is the object of this invention to provide a flexible digitizer tablet with the advantages thereof which does not have the disadvantages adjacent the edges relative to signal interference of prior art flexible digitizer tablets.

Other objects and benefits of the invention will become apparent from the detailed description which follows hereinafter when taken in conjunction with the drawing figures which accompany it.

Summary:

The foregoing object has been achieved by the flexible digitizer tablet of the present invention for sensing the position of a cursor coil radiating a magnetic field therefrom and thereby a cursor carrying the cursor coil without signal interference and distortion adjacent edges of an active area of the tablet comprising, a bottom layer of a flexible insulating material; a grid of wires on a flexible substrate comprising the active area of the tablet; and, a shunt layer of a flexible metal foil disposed between the substrate carrying the grid of wires and the bottom layer.

In the preferred embodiment, the shunt layer is an aluminum foil and the aluminum foil is between 0.5 mil and 1.5 mil in thickness. Additionally the shunt layer is adhesively attached to the substrate and the bottom layer with a spacing layer. The preferred spacing layer is a plastic film having an adhesive on both sides thereof.

Preferably, the shunt layer is spaced at a distance from the grid of wires which allows a portion of the magnetic field to be unshunted in an amount which develops a sufficient positional sensing signal in the grid of wires for sensing the position of the cursor coil and thereby the cursor.

Description of the Drawings:

Figure 1 is a simplified drawing of a prior art digitizer tablet of a general type which is not flexible.

Figure 2 is a simplified drawing of a prior art digitizer tablet which is flexible.

Figure 3 is a simplified cutaway drawing through a portion of the flexible digitizer tablet of Figure 2 showing the layers of which it is composed.

Figure 4 is a simplified cutaway drawing through a portion of a flexible digitizer tablet according to the present invention showing the layers of which it is composed.

Figure 5 is a simplified drawing adjacent the edge of a portion of the flexible digitizer tablet of Figure 2 showing the wire types disposed therein and the coil of the cursor with its generated magnetic field to illustrate a problem of prior art flexible digitizer tablets.

Figure 6 is a simplified drawing adjacent the edge of a portion of the flexible digitizer tablet of Figure 4 showing the wire types disposed therein and the coil of the cursor with its generated magnetic field as modified by the structure of the present invention to remove the problem shown in Figure 5.

Description of the Preferred Embodiment:

The construction of a prior art flexible digitizer tablet is shown in Figure 3. The tablet 12' comprises a bottom layer 28 of a flexible substrate material. The grid layer 30 (including the repeat wires 22, interconnecting wires 24, and return wire 26 as described above) is typically formed on the bottom layer 28 using normal printed circuit techniques. The grid layer 30 is then covered with a protective top layer 32 to prevent the sliding movement of the

cursor 14 over the surface the tablet 12' from wearing and damaging the conducive "wires" of the grid layer 30.

The construction of the flexible digitizer tablet of this invention is shown in Figure 4 and the results thereof with respect to the above-described problem to be solved are depicted in Figure 6. The tablet 12" again includes a bottom layer 28'. The bottom layer 28', however, is not of a flexible substrate material. Rather, it is preferably of a heavy plastic or rubber. The bottom layer 28' has a metal foil 34 adhesively attached over the extents thereof. Aluminum foil has been used with success in thicknesses of from 0.5 mil to 1.5 mil. The thickness only needs to be sufficient to provide the shunting action to be described in detail shortly. If the foil 34 is too thick, flexibility is impaired, costs of manufacture are increased, and the excessive thickness is merely wasted as far as the function to be performed.

The grid layer 30' (again including the repeat wires 22, interconnecting wires 24, and return wire 26 as described above as well as the necessary dielectric layers) is of unitary construction formed on a suitable thin flexible substrate material using normal printed circuit techniques. The grid layer 30' is adhesively attached to the aluminum foil 34. The most convenient method has been found to employ a spacer layer 36 of a material known as "mac tack" which is a thin Mylar having adhesive on both sides. The grid layer 30' is then again covered with a protective top layer 32 to prevent wearing and damaging the conducive "wires" of the grid layer 30 from the sliding movement of the cursor 14 over the surface the tablet 12'. While not part of the novelty of the present invention per se, so-called Lexan plastic has been found to give preferred results as the protective top layer 32.

The effect of the foregoing construction is shown in Figure 6. Metal, of course, will conduct and "shunt" magnetic fields. In this case, the close proximity of the metal foil layer to the grid layer 30 causes the magnetic field 38 produced by the coil 20 which extends outward surrounding the coil 20 to be shunted into a close proximity surrounding the coil 20 as illustrated in the drawing figure. Thus, as the coil 20 is brought close to the edge of the

working area of the tablet 12", the magnetic field 38 is insufficiently large so as radiate significantly into the repeat wires 22, interconnecting wires 24, and return wire 26 and any significant interference with the data indicating the position of the coil 20 (and thereby the cursor 14) on the surface of the tablet 12" is eliminated.

As those skilled in the art will undoubtedly recognize immediately, by reducing the size of the radiated magnetic field 38 the signal induced into the sensing wires of the grid layer 30 is also reduced. Note, however, that the shunting effect of the metal foil layer 34 is spaced from the actual sensing wires of the grid layer 30 since they are on the top of the substrate thereof and there is also the spacer layer 36 interposed between the grid layer 30 and the metal foil layer 34. This spacing is sufficient to allow the magnetic field 38 to radiate a sufficient distance before being shunted that a signal sufficient for sensing purposes is generated. The signal strength is, of course, somewhat diminished from an unshunted tablet; but, in tests of the present invention, the results were very favorable in that sufficient signal strength was present to determine the position of the coil 20 with usual accuracy while the problems of edge interference were eliminated. Should the foil layer 34 be positioned hard against the sensing wires of the grid layer 30 instead of being spaced therefrom as described, the story would probably be a different one in that the magnetic field 38 would probably be fully shunted and eliminate the development of a sufficient field 38 for proper positional sensing purposes.

Wherefore, having thus described the present invention, what is claimed is:

CLAIMS 6

1. In a flexible digitizer tablet comprising a grid of wires on a flexible substrate, the improvement to eliminate signal interference adjacent edges of a sensing area of the grid of wires comprising:

a shunt layer of a flexible metal foil disposed in close-spaced parallel relationship to the grid of wires.

2. The improvement to a flexible digitizer tablet of claim 1 wherein:

said shunt layer is an aluminum foil.

3. The improvement to a flexible digitizer tablet of claim 1 wherein:

said aluminum foil is between 0.5 mil and 1.5 mil in thickness.

4. The improvement to a flexible digitizer tablet of claim 1 wherein:

said shunt layer is adhesively attached to the grid of wires with a spacing layer.

5. The improvement to a flexible digitizer tablet of claim 4 wherein:

said spacing layer is a plastic film having an adhesive on both sides thereof.

6. The improvement to a flexible digitizer tablet of claim 1 wherein:

a) the grid of wires develops a positional sensing signal as a result of a magnetic field from a cursor coil positioned thereover passing therethrough;

b) said shunt layer is of a thickness sufficient to shunt said magnetic field; and,

c) said shunt layer is spaced at a distance from the grid of wires which allows a portion of said magnetic field to be unshunted in an amount which develops a sufficient positional

sensing signal in the grid of wires for sensing the position of said cursor coil and thereby a cursor carrying said cursor coil.

7. A flexible digitizer tablet for sensing the position of a cursor coil radiating a magnetic field therefrom and thereby a cursor carrying the cursor coil without signal interference and distortion adjacent edges of an active area of the tablet comprising:

a) a bottom layer of a flexible insulating material;

b) a grid of wires on a flexible substrate comprising the active area of the tablet; and,

c) a shunt layer of a flexible metal foil disposed between said substrate carrying said grid of wires and said bottom layer.

8. The flexible digitizer tablet of claim 7 wherein:
said shunt layer is an aluminum foil.

9. The flexible digitizer tablet of claim 7 wherein:
said aluminum foil is between 0.5 mil and 1.5 mil in thickness.

10. The flexible digitizer tablet of claim 7 wherein:
said shunt layer is adhesively attached to said substrate and said bottom layer with a spacing layer.

11. The flexible digitizer tablet of claim 10 wherein:
said spacing layer is a plastic film having an adhesive on both sides thereof.

12. The flexible digitizer tablet of claim 7 wherein:
said shunt layer is spaced at a distance from said grid of wires which allows a portion of the magnetic field to be unshunted in an amount which develops a sufficient positional sensing signal in said grid of wires for sensing the position of the cursor coil and thereby the cursor.

13. In a flexible digitizer tablet used for sensing the position of a cursor coil of a cursor disposed thereon which is radiating a magnetic field therefrom and thereby the position of the cursor, the method of construction and operation for preventing signal interference and distortion adjacent edges of an active area of the tablet comprising the steps of:

a) at the time of construction,

a1) employing a bottom layer of a flexible insulating material,

a2) employing a grid of wires on a flexible substrate as the active area of the tablet, and

a3) disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer; and,

b) at the time of operation, shunting a portion of the magnetic field away from the grid of wires through the shunt layer.

14. The method of claim 13 wherein said step of disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer comprises:

adhesively attaching the shunt layer to the substrate and the bottom layer with a spacing layer.

15. The method of claim 13 wherein said step of disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer includes the step of:

spacing the shunt layer at a distance from the grid of wires which allows a portion of the magnetic field to be unshunted in an amount which develops a sufficient positional sensing signal in the grid of wires for sensing the position of the cursor coil and thereby the cursor.

AMENDED CLAIMS

[received by the International Bureau on 20 July 1992 (20.07.92); original claim 4 cancelled; original claims 1-3, 5-14 amended; (3 pages)]

1. In a flexible digitizer tablet comprising a grid of wires on a flexible substrate, the improvement to eliminate signal interference adjacent edges of a sensing area of the grid of wires comprising:

a shunt layer of a flexible metal foil adhesively attached to the grid of wires with an electrically insulating adhesive layer.

2. The improvement to a flexible digitizer tablet of claim 1 wherein:

said shunt layer is an aluminum foil.

3. The improvement to a flexible digitizer tablet of claim 1 wherein:

said metal foil is between 0.5 mil and 1.5 mil in thickness.

4. The improvement to a flexible digitizer tablet of claim 1 wherein:

said electrically insulating adhesive layer is plastic having adhesive on both sides thereof.

5. The improvement to a flexible digitizer tablet of claim 1 wherein:

a) the grid of wires develops a positional sensing signal as a result of a magnetic field from a cursor coil positioned thereover passing therethrough;

b) said shunt layer is of a thickness sufficient to shunt said magnetic field; and,

c) said shunt layer is spaced at a distance from the grid of wires which allows a portion of said magnetic field to be unshunted in an amount which develops a sufficient positional

sensing signal in the grid of wires for sensing the position of said cursor coil and thereby a cursor carrying said cursor coil.

6. A flexible digitizer tablet for sensing the position of a cursor coil radiating a magnetic field therefrom and thereby a cursor carrying the cursor coil without signal interference and distortion adjacent edges of an active area of the tablet comprising:

a) a bottom layer of a flexible insulating material;

b) a grid of wires on a flexible substrate comprising the active area of the tablet; and,

c) a shunt layer of a flexible metal foil disposed between said substrate carrying said grid of wires and said bottom layer, said shunt layer being adhesively attached to said substrate carrying said grid of wires on one side with an electrically insulating adhesive material and being adhesively attached to said bottom layer on an opposite side with said electrically insulating adhesive material.

7. The flexible digitizer tablet of claim 6 wherein:

said shunt layer is an aluminum foil.

8. The flexible digitizer tablet of claim 6 wherein:

said metal foil is between 0.5 mil and 1.5 mil in thickness.

9. The flexible digitizer tablet of claim 6 wherein:

said shunt layer is adhesively attached to said substrate and said bottom layer with a spacing layer.

10. The flexible digitizer tablet of claim 9 wherein:

said spacing layer is a plastic film having an adhesive on both sides thereof.

11. The flexible digitizer tablet of claim 6 wherein:

said shunt layer is spaced at a distance from said grid of wires which allows a portion of the magnetic field to be unshunted in an amount which develops a sufficient positional sensing signal in said grid of wires for sensing the position of the cursor coil and thereby the cursor.

12. In a flexible digitizer tablet used for sensing the position of a cursor coil of a cursor disposed thereon which is radiating a magnetic field therefrom and thereby the position of the cursor, the method of construction and operation for preventing signal interference and distortion adjacent edges of an active area of the tablet comprising the steps of:

a) at the time of construction,

a1) employing a bottom layer of a flexible electrically insulating material,

a2) employing a grid of wires on a flexible substrate as the active area of the tablet, and

a3) disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer; and,

b) at the time of operation, shunting a portion of the magnetic field away from the grid of wires through the shunt layer.

13. The method of claim 12 wherein said step of disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer comprises:

adhesively attaching the shunt layer to the substrate and the bottom layer with a spacing layer.

14. The method of claim 12 wherein said step of disposing a shunt layer of a flexible metal foil between the substrate carrying the grid of wires and the bottom layer includes the step of:

spacing the shunt layer at a distance from the grid of wires which allows a portion of the magnetic field to be unshunted in an amount which develops a sufficient positional sensing signal in the grid of wires for sensing the position of the cursor coil and thereby the cursor.

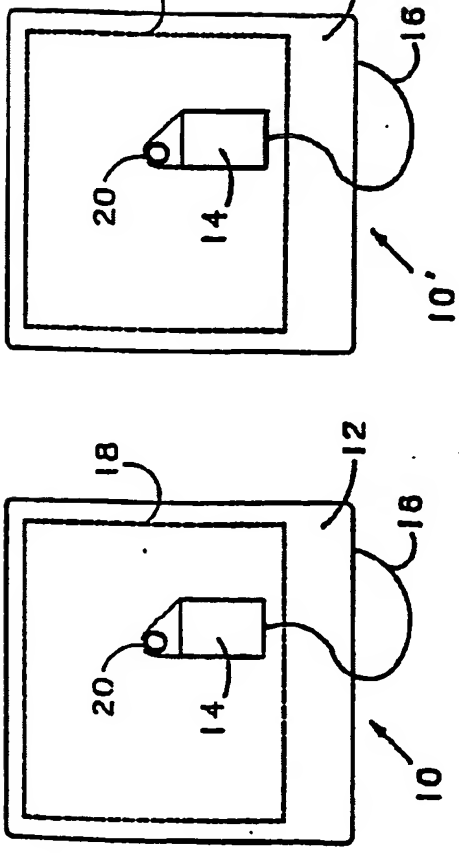


FIG. 1

FIG. 2

FIG. 3

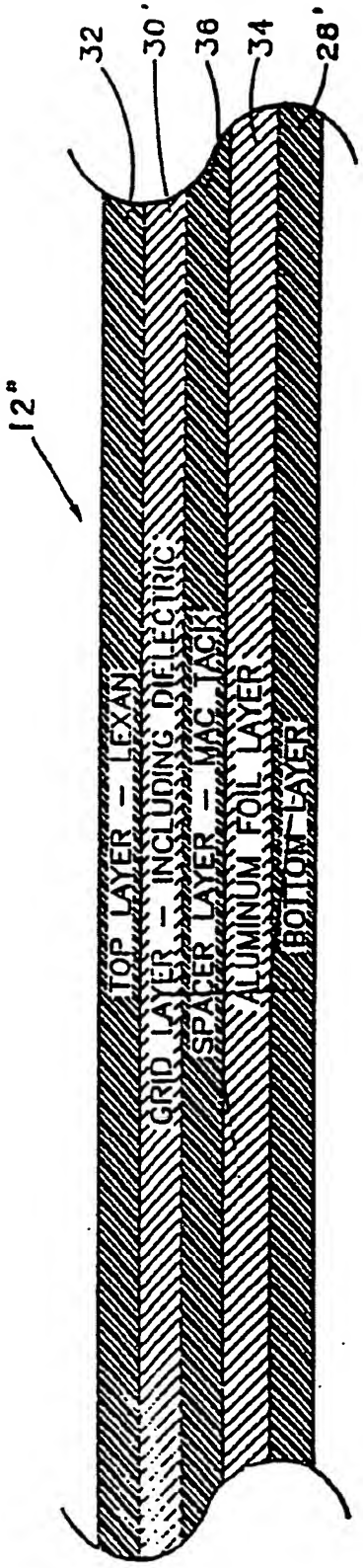
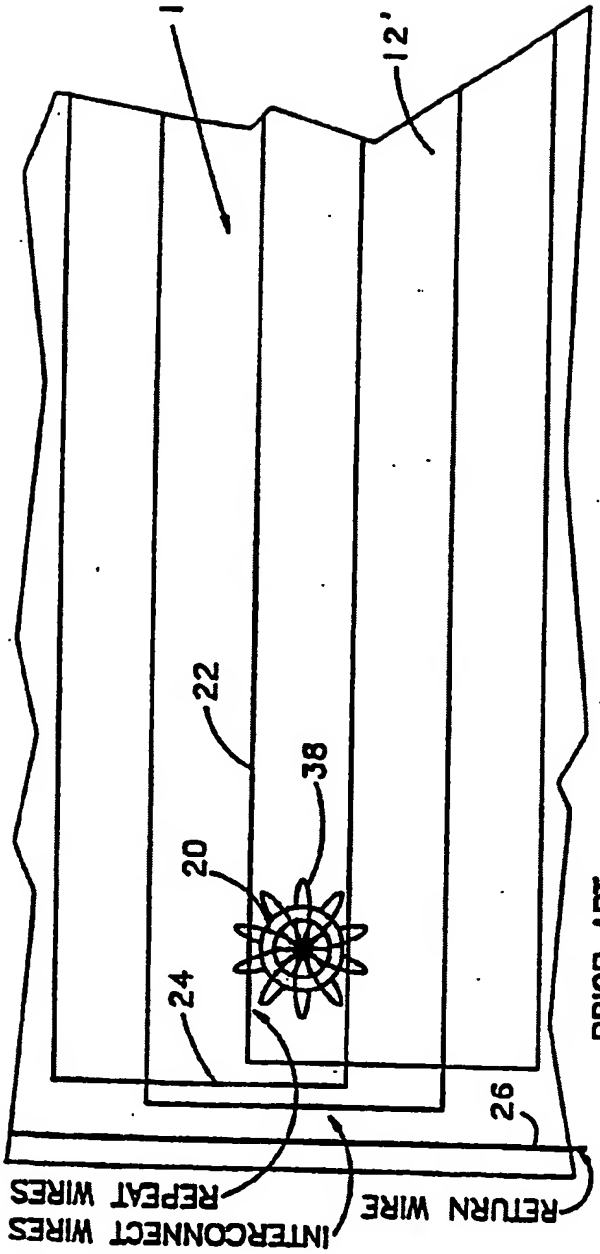


FIG. 4



PRIOR ART
FIG. 5

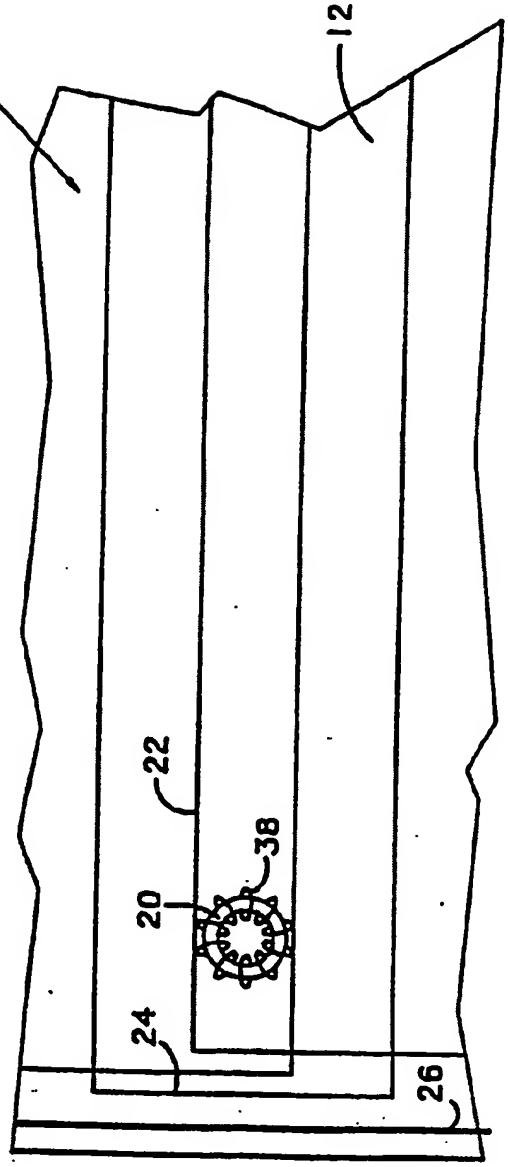


FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/US92/01876

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): B32B 15/02 C08C 21/00

U.S. Cl. 428/256; 178/18, 19; 156/60

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U. S.	428/256; 156/60 178/18, 19

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	US, A, 4,943,689 (SIEFER et al) 24 JULY 1990; See column 2, lines 41-45.	1-15

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
22 APRIL 1992	27 MAY 1992
International Searching Authority	**Signature of Authorized Officer**
ISA/US	Alexander S. Thomas

Form PCT/ISA/210 (second sheet) (Rev.11-87)